



# Motorola PowerQUICC™ MPC852T Pb-Free Packaging Information

**Motorola  
Semiconductor**





# PC852T Pb-Free Packaging Info

- MPC852T PowerQUICC integrated communications processor packaged in a 256 pin Plastic BGA
  - 23x23 mm body (See package drawing next page)
  - 16x16 full array of 0.76 mm diameter solder spheres at 1.27 mm pitch
- To support a cleaner environment, meet market demands and future legislative requirements, MPC852T being offered with optional Pb-free solder spheres
  - Pb-free version designated as MPC852TVR
  - Pb-free sphere composition is 95.5Sn4.0Ag0.5Cu % by weight
  - Most common industry Pb-free composition
  - MPC852TZT has Motorola standard 62Sn36Pb2Ag sphere
- Both versions have high temperature reflow capability to withstand Pb-free soldering
  - MSL or moisture sensitivity level 3 at 245°C peak reflow temperature
  - Pb-free spheres have a melting temp approximately 40°C hotter than standard Pb bearing spheres and solder paste





# 852T 256 PBGA Package Drawing

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**MECHANICAL OUTLINES  
DICTIONARY**

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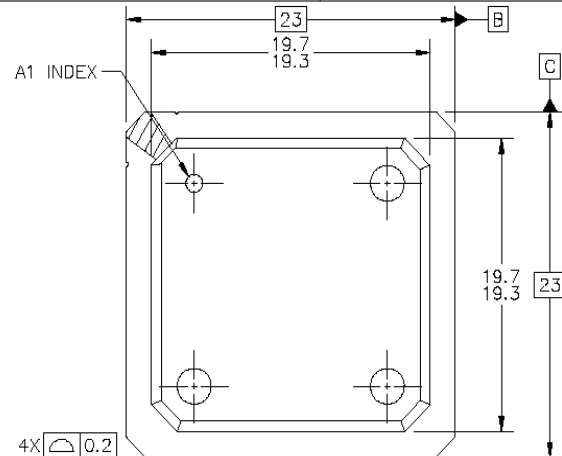
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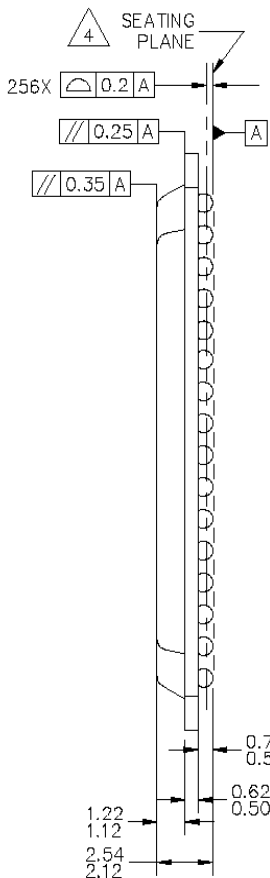
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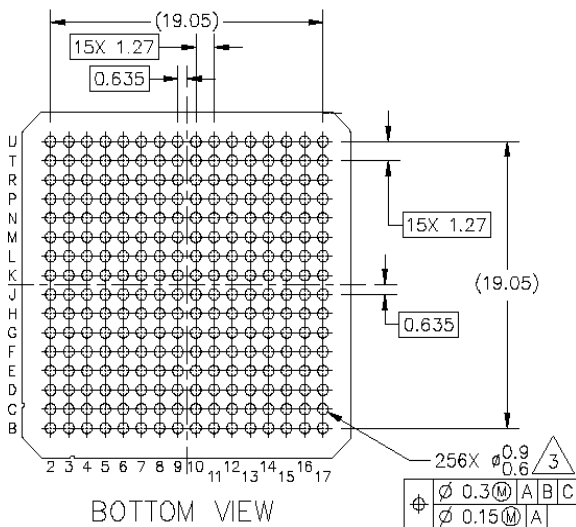
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TOP VIEW



SIDE VIEW



BOTTOM VIEW

NOTES:

- ALL DIMENSIONS ARE IN MILLIMETERS.
- INTERPRET DIMENSIONS AND TOLERANCES PER ASME Y14.5M-1994.
- MAXIMUM SOLDER BALL DIAMETER MEASURED PARALLEL TO DATUM A.
- DATUM A, THE SEATING PLANE, IS DEFINED BY THE SPHERICAL CROWNS OF THE SOLDER BALLS.

TITLE: 256 I/O PBGA  
23 X 23, 1.27 MM PITCH

CASE NUMBER: 1130B-01  
STANDARD: JEDEC MS-034 BAJ-1  
PACKAGE CODE: TBD SHEET: 1 OF 3

TITLE: 256 I/O PBGA  
23 X 23, 1.27 MM PITCH

CASE NUMBER: 1130B-01  
STANDARD: JEDEC MS-034 BAJ-1  
PACKAGE CODE: TBD SHEET: 2 OF 3



# PC852T Pb-Free Packaging Info

- Melting properties of Pb-free versus Pb-bearing solders:

		Composition (Weight %)		
		95.5Sn4.0Ag0.5Cu (Pb-free Sphere)	62Sn36Pb2Ag (Std Pb Bearing Sphere)	63Sn37Pb (Typical Pb Bearing Pastes)
Temp (°C)	Solidus	216	179	183
	Liquidus (Approx. Melt)	222	189	

Source: NIST at <http://www.nist.gov>

- Several options for reflow soldering the Pb-free MPC852TVR:
  - Recommended to solder with Sn-based, Pb-free solder paste
    - 230 to 245°C peak reflow temperature profiles commonly used in conjunction with most Pb-free solder pastes will fully melt the paste and sphere resulting in a reliable interconnection
  - Traditional Pb-bearing solder pastes such as 63Sn37Pb may be used
    - Minimum peak reflow temperature of 220°C required for substantial reflow of the Pb-free sphere
      - Reflow temperatures below 220°C may result in poor assembly yields and/or inadequate interconnect reliability
    - For increased margin, >225°C to 245°C peak temperature preferred to ensure full reflow, collapse of the sphere and joining
- Note that all components must be rated for the peak temp used*



# PC852T Pb-Free Packaging Info

- Motorola has performed board-level interconnect reliability testing on a variety of BGAs with standard SnPbAg versus SnAgCu spheres
- Extensive assembly process study performed using 388 PBGA:
  - 1 mm pitch, 27x27mm body, 0.6 mm sphere, 4 perimeter row package with 36 thermal balls
  - -40 to 125°C thermal cycling used
    - 15 min dwells and 15 min controlled ramps at 11°C/min
    - Cycle used for automotive under-hood testing
    - Typical automotive industry requirements of 1K to 2K cycles
  - Several solder paste and peak temperatures variables used:
    - SnAgCu solder paste with peak reflow of 241°C
    - SnPb solder paste with various peak reflow temperatures:
      - 203, 210, 217 and 225°C
    - All temperatures are the coolest measured on the board
      - Thermocouple embedded into the center sphere for profiling





# PC852T Pb-Free Packaging Info

- 388 PBGA assembly and reliability summary with Pb-free spheres and 63Sn37Pb paste at various peak reflow temperatures:

Peak Temp (°C)	Comment	Example Solder Joints*
203	<ul style="list-style-type: none"> <li>- No sphere collapse</li> <li>- No alloy mixing</li> <li>- Poor assembly yield (opens)</li> <li>- Early failures in temp cycling</li> </ul>	
210	<ul style="list-style-type: none"> <li>- Minimal sphere collapse</li> <li>- Minimal alloy mixing</li> <li>- Poor assembly yield (opens)</li> <li>- Early failures in temp cycling</li> </ul>	
217	<ul style="list-style-type: none"> <li>- Partial sphere collapse</li> <li>- Partial alloy mixing</li> <li>- 100% assembly yield on small sample</li> <li>- Consistent interconnect reliability</li> </ul>	
225	<ul style="list-style-type: none"> <li>- Complete sphere collapse</li> <li>- Complete alloy mixing</li> <li>- Consistent 100% assembly yield</li> <li>- Excellent interconnect reliability</li> </ul>	

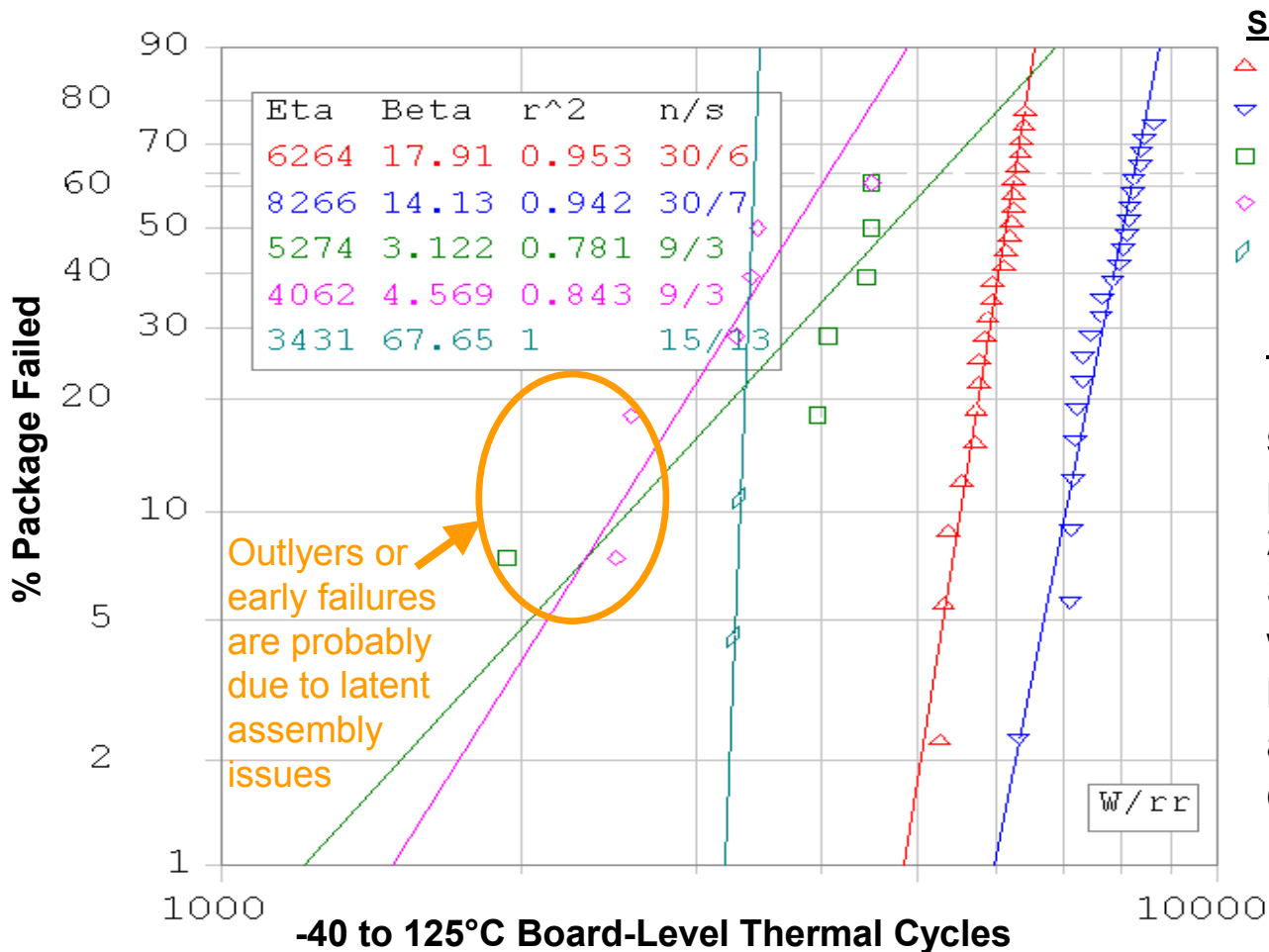
\* Solder joints cross-sections shown are post-thermal cycling and show some evidence of typical fracturing





# PC852T Pb-Free Packaging Info

- 40 to 125°C board-level temp cycling of 388 PBGA with SnAgCu vs. SnPb spheres assembled with different solder paste at various peak reflow temps



### Sphere – Paste – Peak Reflow (°C)

- △ SnPb2Ag - SnPb - 215
- ▽ Sn4Ag0.5Cu - SnAgCu - 241
- Sn4Ag0.5Cu - SnPb - 203
- ◇ Sn4Ag0.5Cu - SnPb - 210
- ◊ Sn4Ag0.5Cu - SnPb - 217

### Notes:

1. Cycles to failure data shown plotted on two parameter Weibull axes.
2. SnAgCu sphere and SnPb solder paste group with 225°C peak reflow has had one fail at 4,300 cycles and is currently at 5,000 cycles.



# 852T Pb-Free Packaging Summary

- Pb-free MPC852T recommended to be assembled with Pb-free solder paste
  - Motorola studies with 241°C peak reflow gave Pb-free interconnect reliability equivalent to Pb bearing
- When PbSn solder paste must be used, ensure that reflow temperature is high enough to provide a reliable interconnection
  - 220°C peak temperature minimum
  - >225°C up to component qualified maximum of 245°C preferred
- In all cases, ensure correct reflow profiling
- Please direct any questions through your Motorola Sales or distributor contact

